U. S. FOREST SERVICE

RESEARCH NOTE LS-49

KE STATES FOREST EXPERIMENT STATION • U. S. DEPARTMENT OF AGRICULTURE

Leaf Blight of Boxelder Attributed to 2,4-D Spray Drift

During the past decade, boxelder "blight" has been a major concern to people involved with tree plantings throughout much of the Northern Great Plains and neighboring parts of Canada. That it is caused by 2,4-D spray drift has been shown by the studies reported here.

The blight became evident on boxelder in North Dakota about the early 1950's, and later a similar condition was noticed on the foliage of other tree species, especially Siberian elm, American elm, and green ash. Symptoms developed each year in late May or early June and sometimes again in August or early September after a short period of recovery. In dry years damage was not as severe or widespread.

The disease apparently affects only the leaves — or in severe cases the branch tips. The leaves become dwarfed and cupped and have frilled margins (fig. 1). Chlorophyll develops a grainy appearance as the leaves become chlorotic. The younger leaves are damaged much more than the older leaves.

Although blight damage seems to be only temporary, the unhealthy appearance of the distorted foliage and uncertainty as to the ultimate effect of repeated damage have contributed in large part to a decline in the former popularity of boxelder as a windbreak species or a shade tree.

Some early investigations were made to determine whether a disease organism — possibly trans-

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FIGURE 1. — Typical blight symptoms on 2-0 boxelder seedling.

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mitted by an insect — was involved. No relationship was found.

Several circumstances associated with the onset of the blight indicated a possible connection with crop spraying with 2,4-D for weed control. The blight had become noticeable at about the same time as spraying for weed control had become widely practiced. Time of spraying in early June and occasionally in late summer coincided with the appearance of the blight. The light damage and scattered incidence during dry years could be accounted for by the less intense weed control activities necessary in these years. The damage symptoms were not unlike those that had been described for certain agricultural crops. New leaves were more severely damaged than the older leaves, which is characteristic of the action of 2,4-D. Lastly, the occurrence of the blight at some distance from the actual spraying operation would presuppose travel of the spray for some distance. Studies have shown that aerial spray drift may move as far as 10 miles or more from the source.

To test the theory that drift was the cause, several different approaches were used. Certain plants, known as indicator plants, are very sensitive to 2,4-D in the atmosphere and indicate its presence by developing typical foliage malformations. Two of these plants — cotton and grape — were grown adjacent to a planting of boxelder seedlings in the Bottineau Nursery, Bottineau, N. Dak., in 1959. Plants of both indicators developed abnormal foliage typical of 2,4-D damage within 10 days of the first sign of boxelder blight. The test was repeated in 1960 with the same results.

2,4-D persists in the tissue of plants in an active form for periods of a few days to several weeks, depending on the plant species. In cotton foliage, 2,4-D has remained active for at least a month after the initial application. It was not known how long boxelder might retain the herbicide in active form.

With this in mind, three tests were selected to detect the presence of 2,4-D in extracts of the abnormal boxelder and cotton leaves:

1. Extracts of the abnormal foliage were applied to healthy plants. If 2,4-D were present, similar malformations should develop in the healthy foliage. Extracts from healthy plants should not induce malformation in healthy foliage.
2. One lot of cucumber seeds was germinated in an extract medium of blighted leaves and another lot in an extract of healthy leaves. Since the primary roots of cucumbers are extremely sensitive to growth inhibitors — such as 2,4-D — less growth would be expected in the abnormal extract than in the extract from healthy leaves.
3. The extract from abnormal foliage was tested with a chemical reagent known as chromotropic acid. If 2,4-D were present, a purple color would develop. No color reaction should develop with an extract from healthy foliage.

Results of the above tests of abnormal cotton and boxelder foliage collected in 1959 and 1960 were positive for 2,4-D except for the colorimetric test of the boxelder foliage collected in 1960. An explanation for this might be that the test was not quite sensitive enough to detect the quantity of 2,4-D present.

From the above results it must follow that boxelder foliage is as susceptible to damage by minute dosages of 2,4-D as the foliage of cotton and grape. To verify this, minute quantities of 2,4-D were applied to healthy boxelder leaf buds, and the least quantity that would produce malformation was noted. This proved to be approximately one-hundredth of a microgram. (One million micrograms equal one gram and about 28 grams equal one ounce.) Therefore, juvenile leaf growth of boxelder was sensitive to as small quantities of 2,4-D as reported for cotton by other investigators.

That the malformations induced in the boxelder leaves were identical to those found on blighted boxelder in the field can be considered as additional evidence that 2,4-D is the cause.

The results of this investigation supported the view, that 2,4-D from spray drift is the cause of boxelder blight. Similar damage to leaves of Siberian and American elms and green ash strongly suggests that these species are also being affected by 2,4-D.

Although it is not known to what extent 2,4-D spray drift may damage or impair the growth of these trees, there is good reason to believe that normal photosynthesis is reduced — the destruction of chlorophyll being indicated by the chlorotic condition — and therefore the manufacture of carbohydrates essential for growth is in turn reduced. If food reserves are restricted over a period of years, trees may eventually suffer permanent damage.

Several states have already had to face this problem of spray drift damage to susceptible crops and have undertaken investigations of ways to reduce hazards involved with aerial application.

In view of the results of this study,[1] it is recommended that applicators use sprays of lowest volatility where possible and seek to minimize drift by using the latest techniques in equipment and application.

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[1] *For a more detailed discussion of the study the following reference should be consulted: Phipps, Howard M. The role of 2,4-D in the appearance of a leaf blight of some Plains tree species. Forest Sci. 9: 283-288. 1963.*

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